NATIONAL BUREAU OF STANDARDS REPORT

10 347

LIVE LOAD STUDIES OF CONVEYOR SYSTEMS AND POSTAL FACILITIES

Interim Report III

2–Story Facilities

for: Post Office Department

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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Interim Report III

2-Story Facilities

by
J. O. Bryson
and
L. E. Cattaneo

for: Post Office Department

September 1970

U.S. DEPARTMENT OF COMMERCE
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2-STORY FACILITIES

by

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1. Introduction

This report presents the results from surveys of occupancy loads in three 2-story mail handling facilities (Houston, Texas; New Orleans, Louisiana; Los Angeles AMF, California). The information presented here is the first level reduction and analysis of the loads data recorded in these facilities. The survey techniques and data evaluation procedures used in the study are described in detail in the first interim report, NBS Report 10141, "Live Load Studies of Conveyor Systems and Postal Facilities." Building occupancy loads and work floor area definitions are given in the second interim report, NBS Report 10262. Also, it is recommended that section 2.3 of NBS Report 10262 be read prior to studying the results presented here. This section presents very briefly the more important factors which influenced the survey procedures and evaluative approach for this study.

2. Description of Facilities

The buildings that are being surveyed for loads in this investigation are classed by the POD as "Major Postal Facilities." A major postal facility is one that has a work floor area greater than 50,000 sq. ft.[1/] The space provided in these facilities is divided generally into four major areas:

1. Workroom area
2. Mail handling support services areas
3. Platform or docking areas
4. Administration, personnel, and public services areas.

The workroom is a large open bay floor in which the mail processing activities are centered. The floor area is lined with regularly spaced structural columns which superficially divide the floor space into "grid squares". With the exception of the public services areas, the other areas serve to support, in different ways, the activities on the workroom floor.

2.1 Houston, Texas

The Houston post office is a two-story building fronted by a 5-story office tower facing south at 401 Franklin Avenue,

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1/ Postal Space Standard and Equipment Layouts Vol. I, POD Publication 37

between Bagby and Louisiana Streets at the north end of the Civic Center. The tower houses the public lobbies on the first floor, and administrative offices and cafeteria on the upper floors. Figures 1 and 2 show the general floor plans of the 1st and 2nd story mail handling areas. Loading platforms extend along the north and west sides of the building. Exclusive of the truck terminal saw-tooth area which occupies its northwest quadrant, the 1st floor encloses approximately 101,000 square feet, gross, of mail handling area; the 2nd floor encloses approximately 154,000 square feet, gross, of mail handling area. Ceiling suspended mechanization, of which there is more than a moderate amount is predominantly on the first floor.

2.2 New Orleans, Louisiana

The post office at New Orleans is a two-story facility fronting east on Loyala Avenue at Julia Street and is contiguous with the Federal Office Building at the northeast corner. The service and lock box lobby, as well as offices, extend along the north half of the front of the building on the first floor; additional offices are directly above this area on the second floor. The general plan of the bulk of the building which is devoted to mail processing is seen in Figures 3 and 4 for the first and second floors respectively. On the first floor, mail platforms extend along the west side of the north

wing and along the north side of the west wing. Railroad docks are located at the west end of the west wing.

Workroom floor space is distributed throughout both stories and is divided into specific work areas for processing mail the majority of which is foreign. The gross space enclosed in the first floor for mail handling is approximately 113,000 square feet and on the second floor, 134,000 square feet. The facility contains a moderate amount of mechanization also seen in Figures 3 and 4, in addition to which are contained letter sorting machines and tray conveyors on the second floor.

2.3 Los Angeles (AMF), California

The Los Angeles Worldway Postal Center is a two-story building located within the limits of the Los Angeles Airport. It faces north on Century Boulevard between Airport Road and Postal Road. The service lobby and offices are located on the first floor at the northeast corner; additional offices are directly above this area on the second floor. Mail handling areas can be seen in Figure 5 for the first floor and Figure 6 for the second floor. A truck platform extends along the north side of the first floor; the corresponding space on the second floor contains areas assigned to support operations. The westerly portion of the first floor

contains a mail handling area of about 58,000 square feet of gross enclosed space; the remainder of the first floor to the east is an airline cart maneuvering area. The mail handling area on the second floor extends over the entire east-west length of the building and contains approximately 110,000 square feet of gross enclosed space. The majority of the conveyor mechanization is suspended from the ceiling of the maneuvering area. The roof of this facility is used for automobile parking.

3. Results

The data collected at the facilities pertain to two general categories of loads: (1) Ceiling loads; and (2) Floor loads.

3.1 Ceiling Loads

Calculations were made to determine values for the total load equally distributed over the horizontal area for each mechanization section. In addition, the hanger loads for conveyor suspension rods were calculated for one of two different support arrangements: (1) with suspension rods located at the four corners for small conveyor sections; (2) with suspension rods supporting large sections of mechanization at every 5 ft. in a rectangular coordinate grid. The four-corner support calculations were made for conveyor sections with areas 75 sq. ft. or less (the smallest section examined was 4' x 3' = 12 sq. ft.). The 5-ft. rectangular grid support points were chosen since they conform to the POD specification for the arrangement of insert anchor-points for the support of suspended mechanization systems.

The locations of suspended mechanization sections measured for weight estimates at the three two-story facilities are indicated on the plans in Figures 7, 8, and 9. In Houston and Los Angeles a variety of sections were included in the

measurements. The data collected from these facilities were reduced to ceiling loads for the mechanization sections investigated and are presented in Tables 1 and 2, for Houston and Los Angeles, respectively. In New Orleans, however, the weights of all the mechanization units located in an area of concentration were lumped into only one sum. The area covered one grid square, K-13, on the second floor.

Grid K-13 is one of three grid squares containing mechanization which comprises the Outgoing Parcel Post Primary Separation Unit. By observation, grid square K-13 was selected as the one containing the most mechanization. The Parcel Post Primary Separation Unit is a multi-belt system. Belt conveyors receive manually distributed parcels for conveyor and chute transportation to secondary units. Mechanization includes a receiving conveyor, E-1, from which loose parcels are taken manually and distributed through chutes to take-away conveyor belts for transport to chutes that lead to the first floor. The three grids, mentioned above, contain mechanization which is really part of an outgoing parcel post activity, (Work Area Code 7), but are not considered as part of the floor space making up such a work area. The structural support for the mechanization within these three grids is an integral part of the main structural framing of the building. The floor slab does not exist in the two outer grid squares (leaving full grid

square floor openings for passage of mechanization); and the floor slab of the middle grid, K-13 is bridged by the mechanization. However, weight estimates were made, assuming that such totally ceiling-suspended loads might occur. The section of the mechanization observed for weight estimation in grid K-13 includes 16 25-ft lengths of belt conveyors as well as numerous chutes and other miscellaneous mechanization construction. Specific portions of mechanization which traverse this section are identified in Figure 8. The data collected from New Orleans were reduced to uniformly distributed loads for the one grid square as a whole and are shown in Table 3 as if entirely suspended as ceiling loads.

As in preceding reports, it is to be noted that values for uniformly distributed loads were computed for dead weights of mechanization sections alone (UDL) and for mechanization with design live load added on to the conveyor belt areas where they would occur (UDL_2). The design live loads (mail) used are those currently specified by POD (30 psf). The computed hanger rod loads for the 5 ft-spaced coordinate grid support points are based on the minimum number of support points in a 5 ft grid system which fall within the plan area of the mechanization.

The ceiling loads of mechanization sections selected at Houston are presented in Table 1; they are values of uniformly distributed and concentrated loads caused by conveyors and their structural support. The entire section of mechanization, (A), chosen for estimation of ceiling loads occupies a first-floor (ceiling) area measuring 83 ft. (from the north side of a walkway just north of conveyor EB-2 to the south side of conveyor EC-1) by 140 ft. (from the east side of conveyor EA-3 to the west side of conveyor EB-17), (See Figure 7). Contained in this space are 26 large conveyors used for transport and storage of parcel post sacks. These conveyors are approximately 65 ft. long between their feeding conveyors (EA-2 and EB-2, each with traveling deflector) and their take-away conveyor EC-1. The latter carries the parcel post sacks to a shake-out slide which is in the same general area, but which is floor supported. All mechanization considered in the estimation is ceiling-suspended. Specific reference is made later, in 3.4, to ceiling loads within 4 grid squares (H-14, J-14, H-17, J-17) as well as individual tail, take-up, and head frames. Area A_{ne} contains the tail end of conveyor EA-3 and is typical of the tail ends of the EA conveyors up to and including EA-13. The construction of the tail ends of EB-3 to EB-17 are common to each other and each is represented by area A_{nw}. Each of the areas which contains the take-up roller frame of a north-south EA

or EB conveyor is represented by A_c in common; and A_s similarly represents each of the 26 areas containing equal head-end mechanization. Section B represents an area which contains the head-end and take-up for conveyor EB-2 or EA-2. Section C contains the drive end and take-up of conveyor EC-1; and section D refers to the power turn of EC-1. Also included in the estimation are several slides connecting EA-2, EB-2 and EC-1 to the 26 north-south conveyors.

The mechanization sections in the Los Angeles AMF which were selected for examination are contained in first floor grid square D-15, suspended from the ceiling over the airline cart maneuvering area. The estimated dead weight data in terms of uniformly distributed loads and concentrated loads for these areas are given in Table 2. Also, ceiling loads in these areas have been estimated and tabulated for the condition of dead load plus live load. An enlarged diagram of grid square D-15 is shown in Figure 9. The frame in area A contains a part of conveyor H-3, its take-up construction, and a chute, and assists in supporting part of SSM-1. Section B contains the end of conveyor H-3, drive mechanism, a chute, the tail end of H-4 and assists in supporting SSM-1. Area C contains the head end of conveyor H-3A, its drive mechanism and its take-up roller. The frame in area D supports the head end of conveyor B-4 and its drive mechanism where it

joins B-5. Section E contains part of conveyor B-5A, its take-up pulley and drive mechanisms. Also shown are parts of chutes P-4 and P-5, which receive from SSM-1. These and other miscellaneous constructions such as slides, walkways and framework are included in the overall weight estimate of ceiling-suspended mechanization within grid square D-15.

3.2 Floor Loads

The workroom floor is divided into designated work areas to accommodate specific mail processing activities. The work areas are of different sizes, depending on amount and type of activity, and usually cover a number of grid squares. Within the work areas the activities and types of equipment employed for processing the mail toward its destination are the principal factors which affect the characteristics of the occupancy loads. Table 4 presents the area distribution for the three facilities in terms of amounts of floor space occupied by the various work areas.

The data for the floor loads part of the study was reduced and evaluated with a computer program which was designed to provide information on the loads related to work activity and the geometry of the structure. The computer prints out tables and graphs of principal information and data relationships. From these printouts the maximum values of loadings occurring

on floor areas of different size divisions are presented in Tables 5, 6, and 7 for Houston, New Orleans and Los Angeles, respectively. These were chosen to show the upper limits of loadings occurring in the three facilities at the time of surveying.

Figures 10 through 12 show the relationship between loaded area and discrete load values for the workroom area in each of the three facilities surveyed. The area supporting discrete loads greater than a specific value is given as a ratio of the total loaded area on the vertical axis and the values of discrete load are given along the horizontal axis. Therefore, these plots indicate the fraction of the loaded area which supports loads greater than a particular value of discrete load.

Table 8 gives the percentage of space occupied by load items in each work area for each of the three facilities. In reviewing this data and considering work activities and the associated load items, the conclusion is drawn that occupied space will not exceed 60 percent except in storage areas. This is because the maneuvering space needed for people and mobile equipment to function in activity associated areas is often found to exceed 40 percent and is occasionally found to be 80 percent or more. Storage areas, however, do not require as much free space for maneuvering.

3.3 Analysis of Data

In analyzing the loads data, emphasis was placed on determining characteristic uniformly distributed loads and high load concentrations. However, sight was not lost of the fact that a structure must be designed to safely support all loads that it will be subjected to during its lifetime. In this regard a great deal of attention was devoted to upper limit values of loadings for both ceiling loads and floor loads.

The floor areas on which the loads are applied are divided into two categories: (1) Activity associated areas; (2) Structurally significant areas. The activity associated areas are the work areas. The structurally significant areas are the grid square and grid sector areas.

When there is a change in basic activities on the work floor area of a facility the characteristic loading changes as well. The grid square represents the basic floor and ceiling element that the characteristic loading relates to in terms of first order design loads. Therefore, the loadings within work areas have been evaluated in terms of their effect on grid squares (floor or ceiling structural panels).

Tables 1, 2, and 3 present the suspended mechanization loads recorded in the three facilities. The UDL_2 values for all three facilities range from a low of 32 psf to a high of 340 psf in Los Angeles.

Figure 13 is a plot of the uniformly distributed loads (UDL_2) for the mechanization sections versus the plan areas of the sections. This curve was originally constructed using only the data from the 1-story facilities. However, the addition of the data from the 2-story facilities appears to support the validity of the assumed upper limit load value boundary curve. The sections covering areas larger than 50 sq. ft. impose loads that are less than 100 psf. The pronounced change seen in the slope of the upper limit boundary curve occurs near the 100 psf value. The areas covered by the grid squares for the 2-story facilities are 756 sq. ft., 700 sq. ft., and 1152 sq. ft. for Houston, New Orleans, and Los Angeles, respectively. The values of uniformly distributed load on the upper limit boundary curve which correspond to the grid square areas for the three facilities are 80 psf for Houston, 80 psf for New Orleans, and 75 psf for Los Angeles.

The analysis of the floor loads data was carried out in the same way for the 2-story facilities as was done for the 1-story facilities. The floor loads data from the surveys

include information that is area associated in terms of activity divisions and structural divisions. The data presented in Tables 5, 6 and 7 show the maximum floor loadings found on different size areas. This tabulation shows very clearly that as the area gets smaller the loading approaches the maximum discrete load value which by definition is the limit. The maximum loading recorded was 137 psf on a grid sector in New Orleans. However, the grid square stands as the most structurally significant area for studying design loading. Consequently, the data need to be analyzed from the standpoint of a probable maximum loading on grid squares. The curves giving the cumulative fractions of loaded areas for discrete load values by work areas can be conveniently used for this analysis. These curves are composed of surveyed loads and their respective areas set up to show the variation in discrete loads on the loaded area. Within a work area, there are different types of items used in the mail processing operations. The weights of the items that contain mail vary from some minimum to a maximum value depending on the amount of mail being carried. Therefore, in a work area where there are different sizes and types of items containing different amounts of mail, the discrete loads range over a wide spread in values. The fractions of the loaded area corresponding to discrete load values in a work area are

indicative of the relative loading characteristics in terms of magnitudes and distributions.

The cumulative curves of discrete loads for each of the work areas from all three facilities were used to obtain a load profile to be applied on a grid square area. The load profile used effectively optimizes the loading on the panel for maximum bending moment. This means that the maximum values of actual loadings recorded during the field surveys of the facilities were arranged to impose the most severe bending moment effect on a grid square area. In this way actual loadings were used to arrive at values for the maximum loadings likely to occur from the various activities being conducted in each of the work areas.

Figure 14 illustrates the procedure used in applying the load values from cumulative curves to grid square areas for maximum loading effect. This example is the same one given for 1-story facilities (NBS Report 10262) where the cumulative curve for work area 1 in the Greensboro facility was used. The total area for work area 1 is 8512 sq. ft. and the loaded area is 1741 sq. ft. or approximately 21 percent of the total area. It is this loaded area (1741 sq. ft.) that is represented by the vertical axis (ordinate) for the curve. The area for the grid square in Greensboro is 1089

sq. ft. which is 62 percent of the loaded area for work area 1. The portion of the cumulative curve from 0 to 0.62 area ratio is equal to the grid square area size. This lower portion of the curve also includes the heaviest discrete loads encountered in the work area. These loads are ordered according to weight along the horizontal axis and according to relative area covered, along the vertical axis. Figure (a) of 14 shows how the areas for the respective discrete loads are arranged on a grid square panel for maximum effect on bending moment. The panel is next considered as a 1-way simply supported slab and the load profile on a 1 ft. wide strip through the center of the panel is constructed as shown in (b) of Figure 14. The maximum moment caused by this loading arrangement is computed, and from it an equivalent uniformly distributed load (EUDL) is determined by use of the following relationship,

$$EUDL = \frac{8M}{\ell^2}$$

where,

M = maximum bending moment

ℓ = span length

The values of EUDL for the work areas in each of the facilities surveyed are presented in Table 9.

3.4 Comments

The comments which follow are based on the data from the 2-story facilities. As such, they are made in the light of qualifying remarks also expressed in the preceding interim report to which the reader is again referred but which are repeated here, in part, for ease of reference.

The overall plan for the study of loads on postal mail handling facilities was designed to have the data from each phase of the investigation be applicable to all phases of the study. This is to say that, although the investigation was generally divided into groups of facilities according to their number of stories, the final results would need to be based on data from all facilities in order to broaden the sample information for any one group sufficiently for design load analysis. The rationale is that characteristics of loadings within work areas (i.e., loadings caused by specific activities) are independent of the number of stories in a facility. Consequently, the results presented here are considered preliminary and will be re-evaluated in a later final report covering all facilities surveyed. Further, as has been previously noted, the information presently available does not reflect conditions during peak periods such as the Christmas season. Particularly, efforts to obtain peak values of bulk mail conveyor loads have not been as productive as desirable, and it is considered

advisable to obtain some additional data for this element of the facility loading.

In considering the ceiling loads of Table 1, for Houston, the question arises whether the UDL values for A_{ne}, A_c or A_s, when applied over the area occupied by a set of five equal frames, might result in a plotted point in Figure 13 that falls outside the assumed upper limit boundary load values which the curve represents. It should be noted, however, that in calculating the overall area occupied by five adjacent frames, the additional area of the included spaces between them has the effect of decreasing the computed UDL for five frames, to a value less than that obtained for a single frame. The re-calculated values for multiple frame consideration in all three cases mentioned above (A_{ne}, A_c and A_s would, if plotted, fall within the assumed boundary curve of Figure 13. To illustrate, the A_s values (which, of the three above cases, come closest to the boundary curve upon re-calculation for five frames) are 96 psf applied over 168 square feet.

Further consideration of the Houston mechanization ceiling load estimates showed that in comparison with a UDL_2 of 49 psf for the entire section, A, (cf. p. 9), the UDL_2 values calculated for specific whole grid squares, H-14, J-14, H-17 and J-17 were not far different; they were, respectively,

45, 47, 47 and 47 psf. It is noted that the plotted mechanization load values of Table 2 (Los Angeles) and Table 3 (New Orleans) also fall within the assumed boundary curve although the latter is a borderline case. The curve of Figure 13 is the same one used for 1-story facilities (discussed in Interim Report II) extended at its ends to include some additional values. It appears that the assumed upper limit boundary curve is still applicable for the data collected thus far from both the one- and two-story facilities examined.

It should be noted that the values of floor loadings for grid squares and sectors in Tables 5, 6 and 7 are maximums, as indicated, which were encountered in the survey but which often are isolated cases and not necessarily typical. For example, in Table 5, (Houston) the maximum grid square UDL (58.8 psf in an 88% occupied grid square) occurred in a single grid square used for temporary storage of out-sized parcel post on nutting trucks. A more illustrative case of accumulated loaded nutting tracks is seen in Figure 15 (photographed at New orleans) for which the 48% occupied grid square had a UDL of 36 psf. Note also that the maximum sector UDL of 137 psf in Table 6 (caused by sacks of parcel post stacked on the floor) is in a grid square having a UDL of only 24 psf. The manner of floor loading involved is illustrated

by a similar, though less marked, case illustrated in Figure 16 (also photographed at New Orleans) for which the grid square UDL was 19 psf. A broader view of the floor loadings is given by the loaded area cumulative fraction curves for work areas and for total buildings, as seen in Figures 10, 11 and 12. Nevertheless, the use of such cumulative fraction curves for work areas, in computing equivalent uniformly distributed loads for grid squares (EUDL) by the method described, leads to conservative values.

The EUDL values for grid square floor loads presented in Table 9 are maximum values derived from surveyed loadings within work areas. These values are considered very conservative even though computed from surveyed data. Such an evaluative approach has been used, however, in order to obtain comparisons of loading values by using surveyed data samples which are of limited number and sometimes not too resemblant. For example, no allowance is made for maneuvering space which varies in different work areas; and all grid square panels are considered as one-way slabs.

With the foregoing comments in mind, the following preliminary values were determined as a summary of the information developed thus far from loads in the 2-story facilities surveyed:

(1) For bulk mail load on storage conveyors - - 30 psf

(2) For suspended mechanization loads - - 100 psf

(3) For live floor loads - - 160 psf

Since the data for bulk mail load on storage conveyors were not satisfactorily augmented during the survey of 2-story facilities, value (1), above, remains at 30 psf as presented in Interim Report II (1-Story Facilities) for the reasons discussed therein. Acquisition of additional data pending, the value of 30 psf is considered satisfactory until further investigation shows otherwise.

As discussed earlier in this report (3.3, 3.4) the development of an upper limit curve for suspended mechanization loads and related occupied areas (Figure 13) in 1-story facilities is still applicable to the data gathered in 2-story facilities. The narrow spread of boundary curve mechanization load values (70 to 80 psf) for grid square areas in the different facilities further prompts the retention of value (2), above, at 100 psf for the reasons already given.

The preliminary live floor load value, (3) above, is very likely overly conservative as explained before; it is presented here, for the interim, as the result of a consistent method of comparison. More circumstantial and comprehensive CONSIDERATION of the data may well reduce this value.

4. Tables and Figures

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HOUSTON

Mechanization Section	Total Material Weight (lb)	Plan Area of Section (sq. ft.)	Gross* UDL, W/O L.L. (PSF)	Gross UDL$_2$ Incl. Conveyor L.L. @30 PSF (PSF)	Hanger Load Assuming 4 - Corner Support		Hanger Load Assuming Support at 5-Ft. Co-ord. Grid Pts.	
					W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)	W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)
A	327,500	11620	28	49	---	---	660	1160
A_{ne}	3,800	60	63	89	950	1130	---	---
A_{nw}	3,600	60	60	87	900	1300	---	---
A_c	1,600	20	80	105	400	520	---	---
A_s	2,500	28	89	116	630	810	---	---
A_e	2,000	40	50	77	500	770	---	---
B	2,000	40	50	---	500	---	---	---
C	2,400	25	96	116	600	730	---	---
D	3,000	132	23	39	---	---	200	340

*UDL = Uniformly Distributed Load; L.L. = Mail Live Load

Table 1 - Ceiling Loads from Suspended Mechanization Sections - Houston, Texas.

LOS ANGELES, AMF

Mechanization Section	Total Material Weight (lb)	Plan Area of Section (sq. ft.)	Gross* UDL, W/O L.L. (PSF)	Gross UDL_2 Incl. Conveyor L.L. @30 PSF (PSF)	Hanger Load Assuming 4 - Corner Support		Hanger Load Assuming Support at 5-Ft. Co-ord. Grid Pts.	
					W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)	W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)
Grid D-15	25,700	1152	22	32	---	---	460	660
A	3,200	48	67	114	800	1370	---	---
B	3,300	12	275	340	820	1000	---	---
C	2,000	16	125	174	500	800	---	---
D	2,500	28	90	136	620	950	---	---
E	2,600	32	81	121	650	970	---	---

*UDL = Uniformly Distributed Load; L.L. = Mail Live Load

Table 2 - Ceiling Loads from Suspended Mechanization Sections - Los Angeles, AMF, California.

NEW ORLEANS

Mechanization Section	Total Material Weight (lb)	Plan Area of Section (sq. ft.)	Gross* UDL, W/O L.L. (PSF)	Gross UDL$_2$ Incl. Conveyor L.L. @30 PSF (PSF)	Hanger Load Assuming 4 - Corner Support		Hanger Load Assuming Support at 5-Ft. Co-ord. Grid Pts.	
					W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)	W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)
2nd Floor K-3	31,200	700	45	84	---	---	740	1400

*UDL = Uniformly Distributed Load; L.L. = Mail Live Load

Table 3 - Ceiling Loads from Suspended Mechanization Sections - New Orleans, Louisiana.

Work Area Code No.	Activity Description	Approximate Area					
		Houston (Grid = 27.5' x 27.5' = 756 sq. ft.)		New Orleans (Grid = 28' x 25' = 700 sq. ft.)		Los Angeles (Grid = 36' x 32' = 1152 sq. ft.)	
		sq. ft.	%	sq. ft.	%	sq. ft.	%
1	Culling, facing & cancelling	22,661	11.7	10,956	4.9	17,424	11.2
2	Letter distribution	66,874	34.5	40,559	18.3	85,217	54.6
3	Main office carriers	------	----	2,100	0.9	------	----
4	Flats distribution	27,902	14.4	17,523	7.9	17,651	11.3
5	Pouching	7,460	3.9	14,339	6.4	18,306	11.7
6	Sawtooth platform area	------	----	------	----	------	----
7	Outgoing parcel post	12,220	6.3	40,481	18.2	8,808	5.7
8	Incoming parcel post	32,748	16.9	30,117	13.6	6,336	4.1
9	Outgoing non-preferential	------	----	------	----	------	----
10	Tempo storage (outside parcels and equipment)	23,838	12.3	65,906	29.8	2,133	1.4
Total Workroom Area Surveyed		193,703	100.0	221,981	100.0	155,875	100.0
Gross Workroom Area		195,349		241,036		165,510	

Table 4 - Distribution of Workroom Floor Space in 2-Story Facilities.

HOUSTON

	Work Floor				Work Area				
	Total Load kips	Area sq.ft.	UDL psf	Occupied Space %	Code	Total Load kips	Area sq.ft.	Maximum UDL psf	Occupied Space %
1st Floor	508	72,330	7.0	29.4	1	56	3,524	15.9	39.2
2nd Floor	1358	121,373	11.2	33.9	1	243	19,137	12.7	36.7
1st & 2nd Floor	1866	193,703	9.4	30.0	1	299	22,661	13.2	37.1

Floor Level	Grid Square					Grid Sector					
	Code Grid sq. (work area)	Work Area UDL psf	Area sq.ft.	Maximum Grid UDL psf	Occupied Space %	Code Sector (Gr. sq.) (Work Area)	Work Area UDL psf	Grid Square UDL psf	Area sq.ft.	Maximum Sector UDL psf	Occupied Space %
1st Floor	J09 (10)	10.7	756	58.8	88	1-2 (J09) (10)	10.7	58.8	47.2	67	100
2nd Floor	K02 (1)	12.7	756	26.3	57	1-2 (E01) (1)	12.7	38.7	47.2	86	80
1st & 2nd Floor	J09 (10)	10.7	756	58.8	88	1-2 (E01) (1)	13.2	38.7	47.2	86	80

Table 5 - Maximum Loadings on Floor Areas of Different Size Divisions at Houston.

	Work Floor				Work Area				
	Total Load kips	Area sq.ft.	UDL psf	Occupied Space %	Code	Total Load kips	Area sq.ft.	Maximum UDL psf	Occupied Space %
1st Floor	1051	101,843	10.3	31.9	3	36	2100	17.2	45.6
2nd Floor	1269	120,138	10.6	32.6	7	85	7235	11.7	38.0
1st & 2nd Floor	2320	221,981	10.5	32.3	3	36	2100	17.2	45.6

Floor Level	Grid Square					Grid Sector					
	Code Grid sq. (Work area)	Work Area UDL psf	Area sq.ft.	Maximum Grid UDL psf	Occupied Space %	Code Sector (Gr. sq.) (Work Area)	Work Area UDL psf	Grid Square UDL psf	Area sq.ft.	Maximum Sector UDL psf	Occupied Space %
1st Floor	C08 (7)	8.9	700	54.9	51	2-3 (C08) (7)	8.9	54.9	43.8	111	95
2nd Floor	E18 (2)	10.8	700	23.5	57	1-2 (P04) (7)	11.7	33.9	43.8	137	96
1st & 2nd Floor	C08 (7)	9.4	700	54.9	51	1-2 (P04) (7)	9.4	33.9	43.8	137	96

Table 6 - Maximum Loadings on Floor Areas of Different Size Divisions at New Orleans.

LOS ANGELES, AMF

	Work Floor				Work Area				
	Total Load kips	Area sq.ft.	UDL psf	Occupied Space %	Code	Total Load kips	Area sq.ft.	Maximum UDL psf	Occupied Space %
1st Floor	561	54,882	10.2	27.4	10	37	2,133	17.2	70.5
2nd Floor	1099	100,993	10.9	30.0	2	617	50,180	12.3	27.9
1st & 2nd Floor	1660	155,875	10.7	29.0	10	37	2,133	17.2	70.5

Floor Level	Grid Square					Grid Sector					
	Code Grid sq. (work area)	Work Area UDL psf	Area sq.ft.	Maximum Grid UDL psf	Occupied Space %	Code Sector (Gr.sq.) (Work Area)	Work Area UDL psf	Grid Square UDL psf	Area sq.ft.	Maximum Sector UDL psf	Occupied Space %
1st Floor	G09 (2)	11.3	1152	17.3	41	1-2 (F10) (2)	11.3	26.3	72	39	89
2nd Floor	B09 (1)	12.2	1152	22.5	63	0-3 (B12) (2)	12.3	27.5	144	125	19
1st & 2nd Floor	B09 (1)	11.8	1152	22.5	63	0-3 (B12) (2)	11.9	27.5	144	125	19

Table 7 - Maximum Loadings on Floor Areas of Different Size Divisions at Los Angeles.

	Work Area	Percentage of Occupied Space			Occupied Area (SQ. FT.)			Total Surveyed Area, (SQ. FT.)		
		1st Flr.	2nd Flr.	1st & 2nd Flr.	1st Flr.	2nd Flr.	1st & 2nd Flr.	1st Flr.	2nd Flr.	1st & 2nd Flr.
Houston	1	39.2	36.7	37.1	1383	7032	8415	3524	19137	22661
	2	.0	27.9	27.9	0	18624	18624	0	66874	66874
	3	.0	.0	.0	0	0	0	0	0	0
	4	.0	33.9	33.9	0	9452	9452	0	27902	27902
	5	.0	23.0	23.0	0	1716	1716	0	7460	7460
	6	.0	.0	.0	0	0	0	0	0	0
	7	18.6	.0	18.6	2274	0	2274	12220	0	12220
	8	29.4	.0	29.4	9613	0	9613	32748	0	32748
	9	.0	.0	.0	0	0	0	0	0	0
	10	33.6	.0	33.6	7999	0	7999	23838	0	23838
	Total	29.4	30.3	30.0	21269	36824	58093	72330	121373	193703
New Orleans	1	.0	28.5	28.5	0	3123	3123	0	10956	10956
	2	34.0	32.3	32.4	1528	11653	13181	4494	36065	40559
	3	45.6	.0	45.6	958	0	958	2100	0	2100
	4	37.0	29.7	32.6	2638	3083	5721	7125	10398	17523
	5	.0	29.1	29.1	0	4167	4167	0	14339	14339
	6	.0	.0	.0	0	0	0	0	0	0
	7	32.7	38.0	29.7	10870	2746	13616	33246	7235	40481
	8	29.8	.0	29.8	8968	0	8968	30117	0	30117
	9	.0	.0	.0	0	0	0	0	0	0
	10	30.5	35.0	33.3	7547	14383	21930	24761	41145	65906
	Total	31.9	32.6	32.3	32510	39155	71665	101843	120138	221981
Los Angeles	1	39.1	37.5	37.8	1464	5125	6589	3744	13680	17424
	2	25.4	27.9	26.9	8890	14017	22907	35037	50180	85217
	3	.0	.0	.0	0	0	0	0	0	0
	4	19.4	28.3	24.4	1478	2832	4310	7632	10019	17651
	5	.0	32.9	32.9	0	6030	6030	0	18306	18306
	6	.0	.0	.0	0	0	0	0	0	0
	7	.0	25.6	25.6	0	2253	2253	0	8808	8808
	8	26.8	.0	26.8	1697	0	1697	6336	0	6336
	9	.0	.0	.0	0	0	0	0	0	0
	10	70.5	.0	70.5	1503	0	1503	2133	0	2133
	Total	27.4	30.0	29.0	15030	30255	45285	54882	100993	155875

Table 8 - Percent of Work Area Space Occupied by Load Items.

Work Area Code	Equivalent Uniformly Distributed Load (EUDL), psf								
	Houston, Floors			New Orleans, Floors			Los Angeles, Floors		
	1st	2nd	1st & 2nd	1st	2nd	1st & 2nd	1st	2nd	1st & 2nd
1	72	155	162	---	138	---	42	129	114
2	---	87	---	44	78	79	69	82	79
3	---	---	---	46	---	---	---	---	---
4	---	97	---	69	63	69	42	55	52
5	---	69	---	---	73	---	---	75	---
6	---	---	---	---	---	---	---	---	---
7	53	---	---	120	120	126	---	60	---
8	61	---	---	81	---	---	47	---	---
9	---	---	---	---	---	---	---	---	---
10	118	---	---	160	113	137	46	---	---

Table 9 - Equivalent Uniformly Distributed Loads (EUDL) Derived from Optimized Loadings on a Grid Square.

FIG 1 - HOUSTON POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

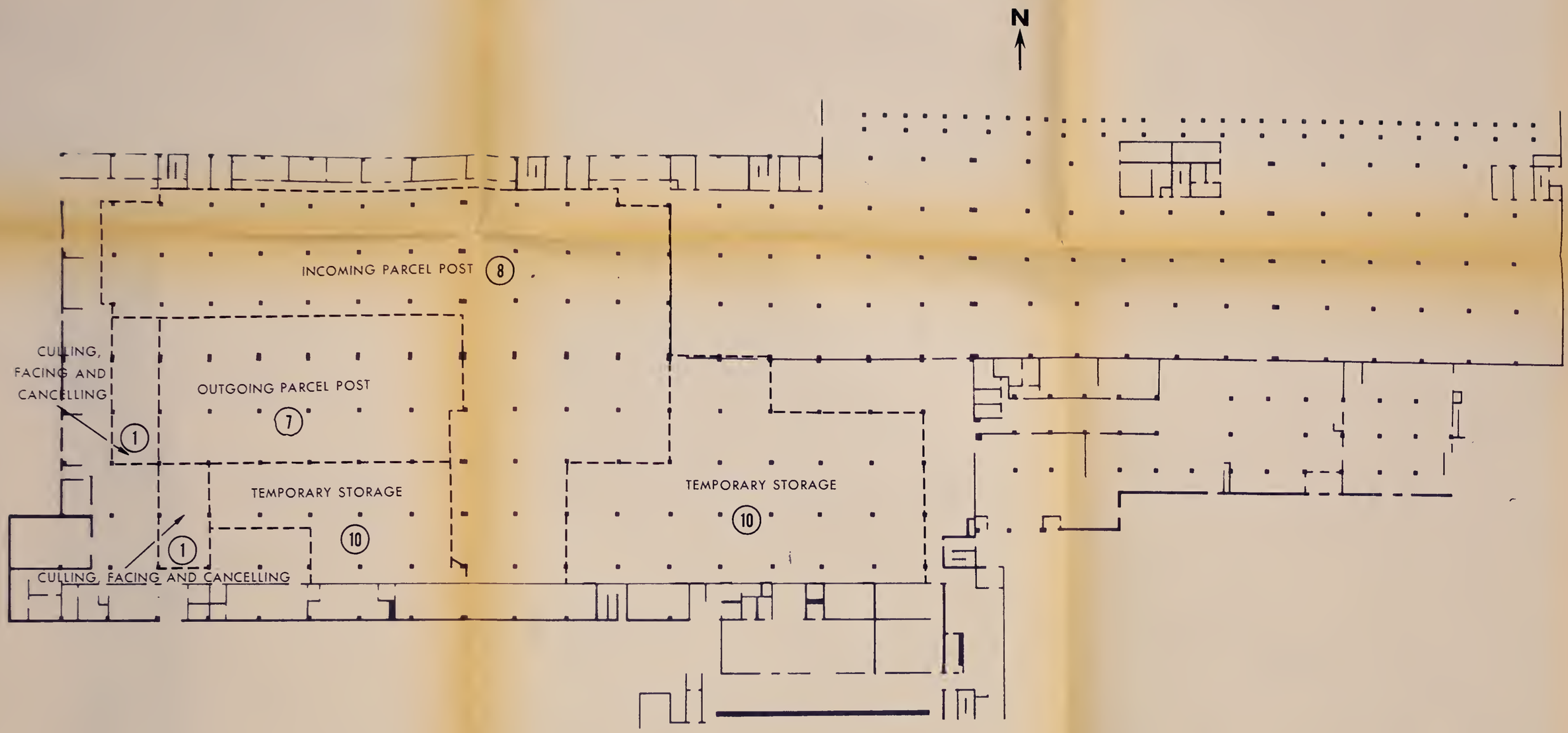


FIG. 1 - HOUSTON POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

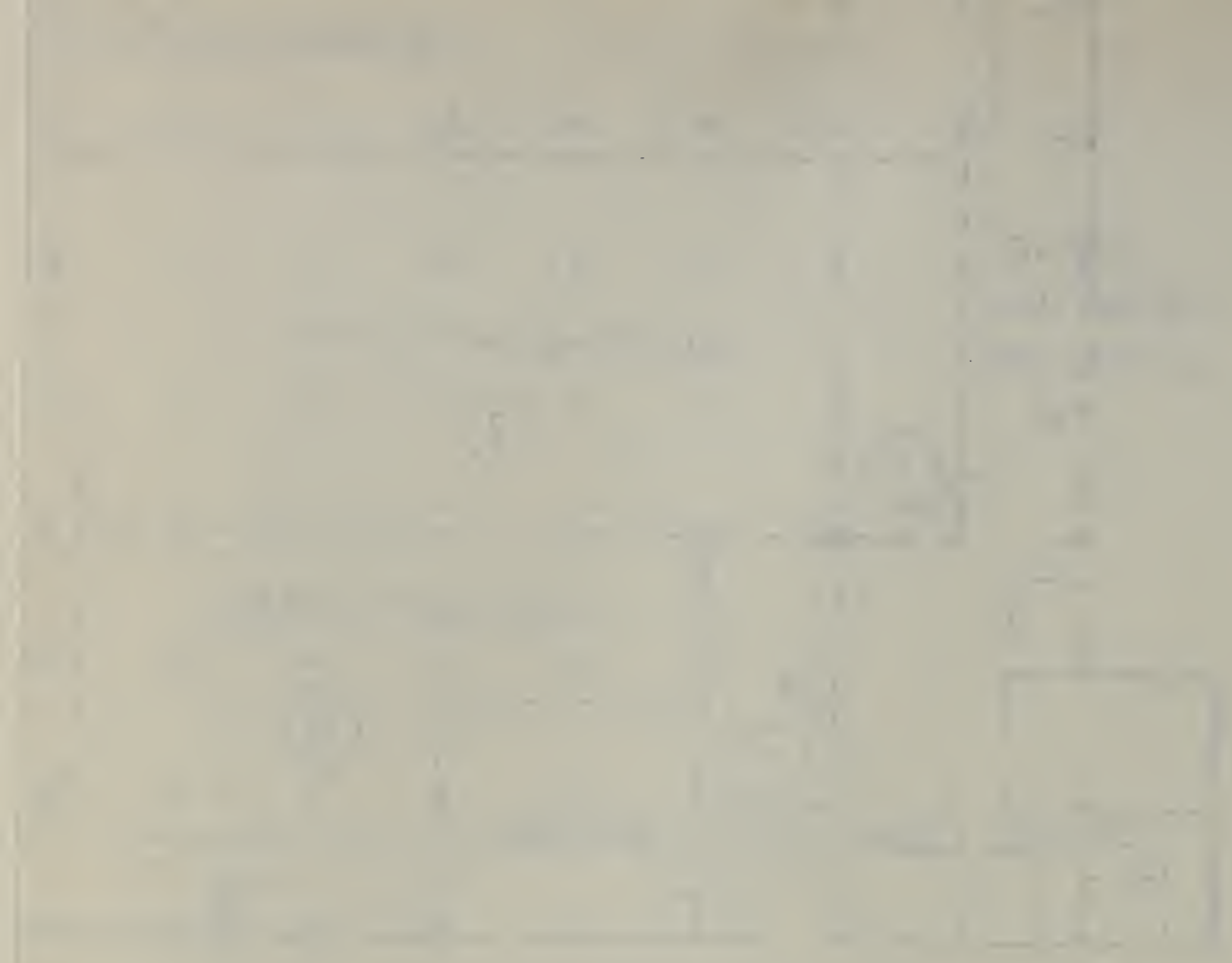


FIG 2 - HOUSTON POST OFFICE SECOND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

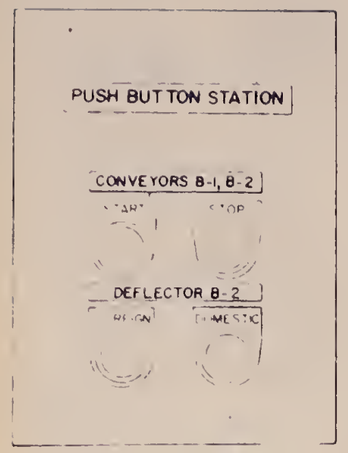


FIGURE 5

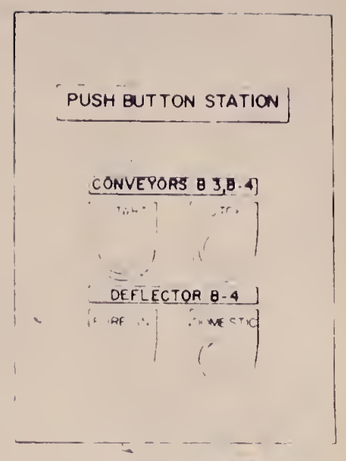


FIGURE 6

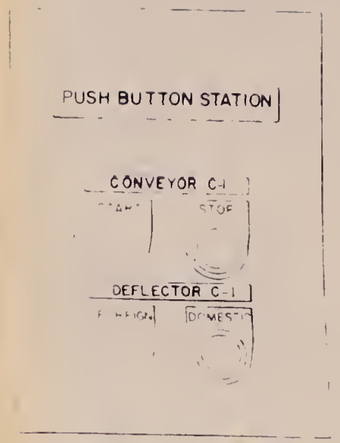


FIGURE 7

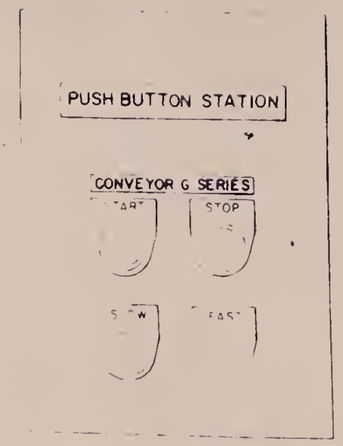


FIGURE 8

FIG. 3 - NEW ORLEANS POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

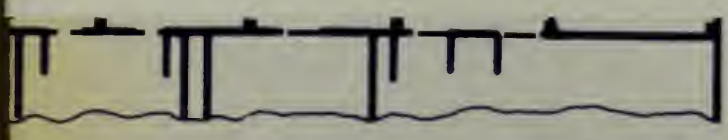
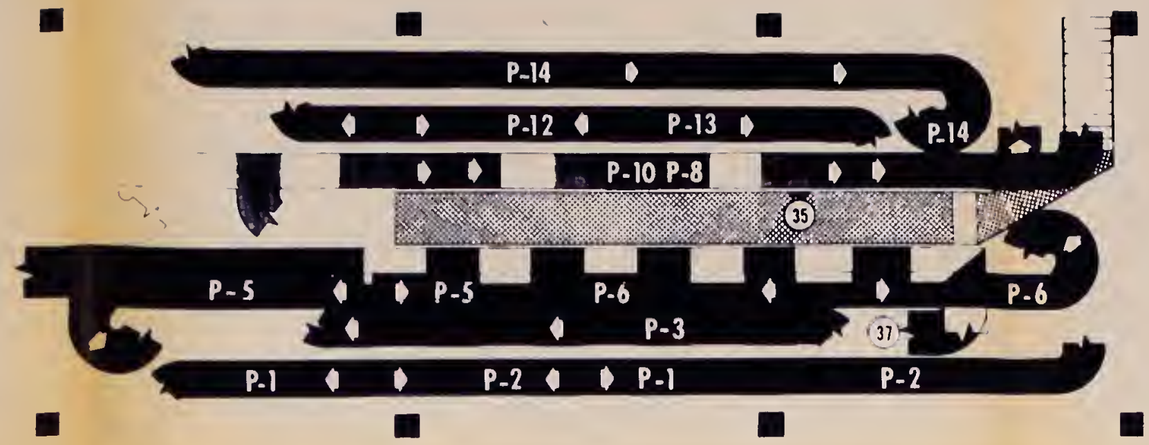
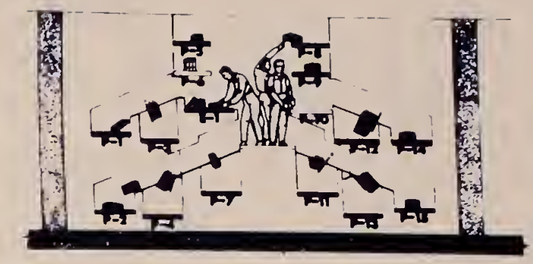


FIG. 3 - NEW ORLEANS POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS



ENLARGED PLAN VIEW
OUTGOING PARCEL POST
PRIMARY SEPARATION UNIT
FIGURE 7



CROSS SECTIONAL VIEW THROUGH
OUTGOING PARCEL POST
PRIMARY SEPARATION UNIT
FIGURE 8

FIG. 4 · NEW ORLEANS POST OFFICE SECOND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

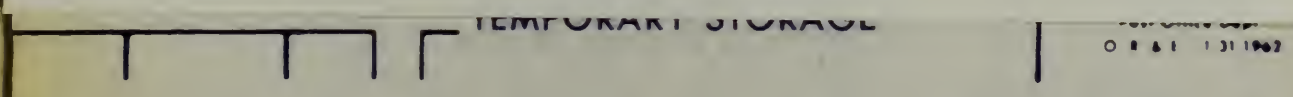


FIG 4 - NEW ORLEANS POST OFFICE SECOND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

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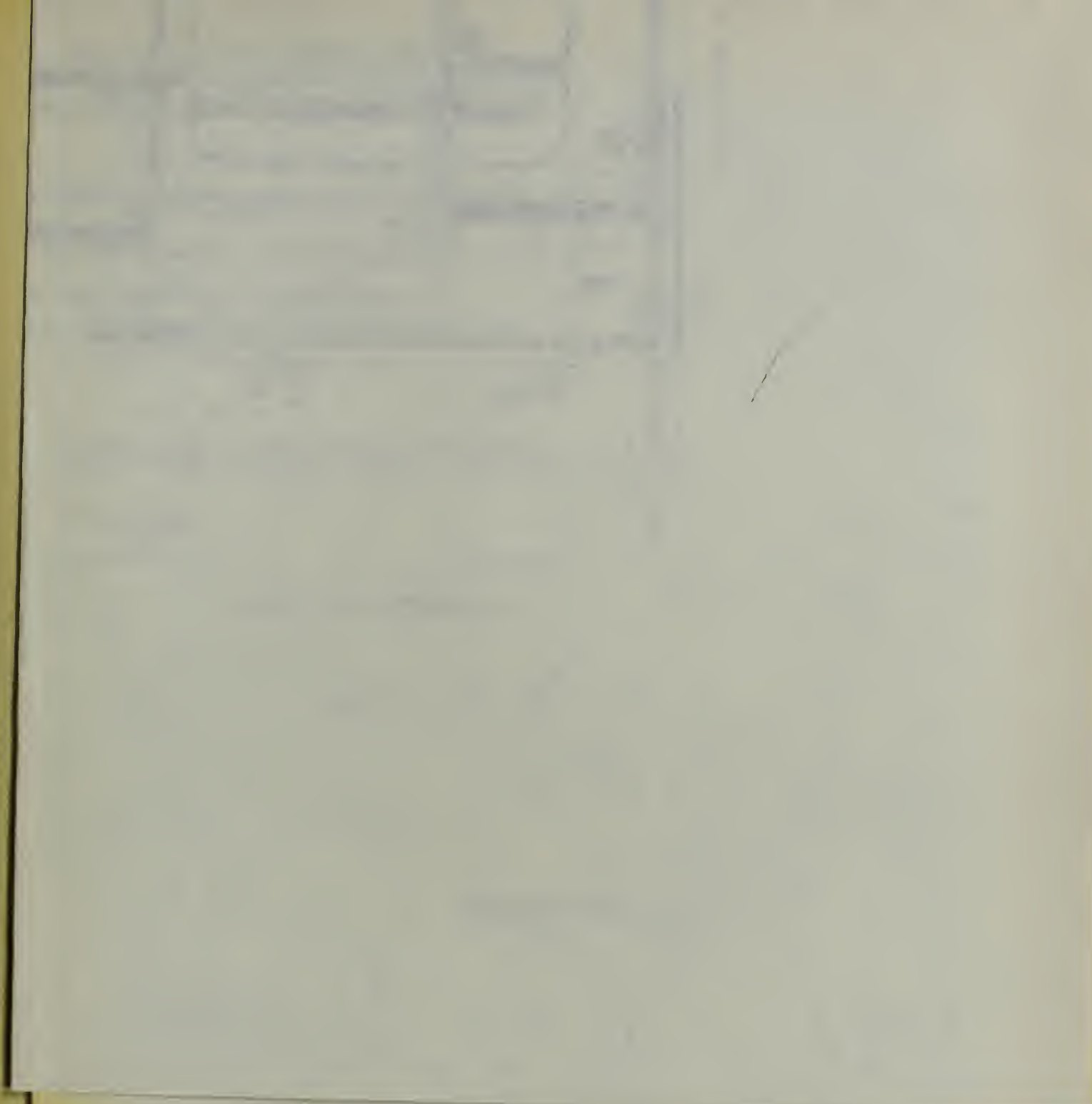


FIG. 5 - LOS ANGELES POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

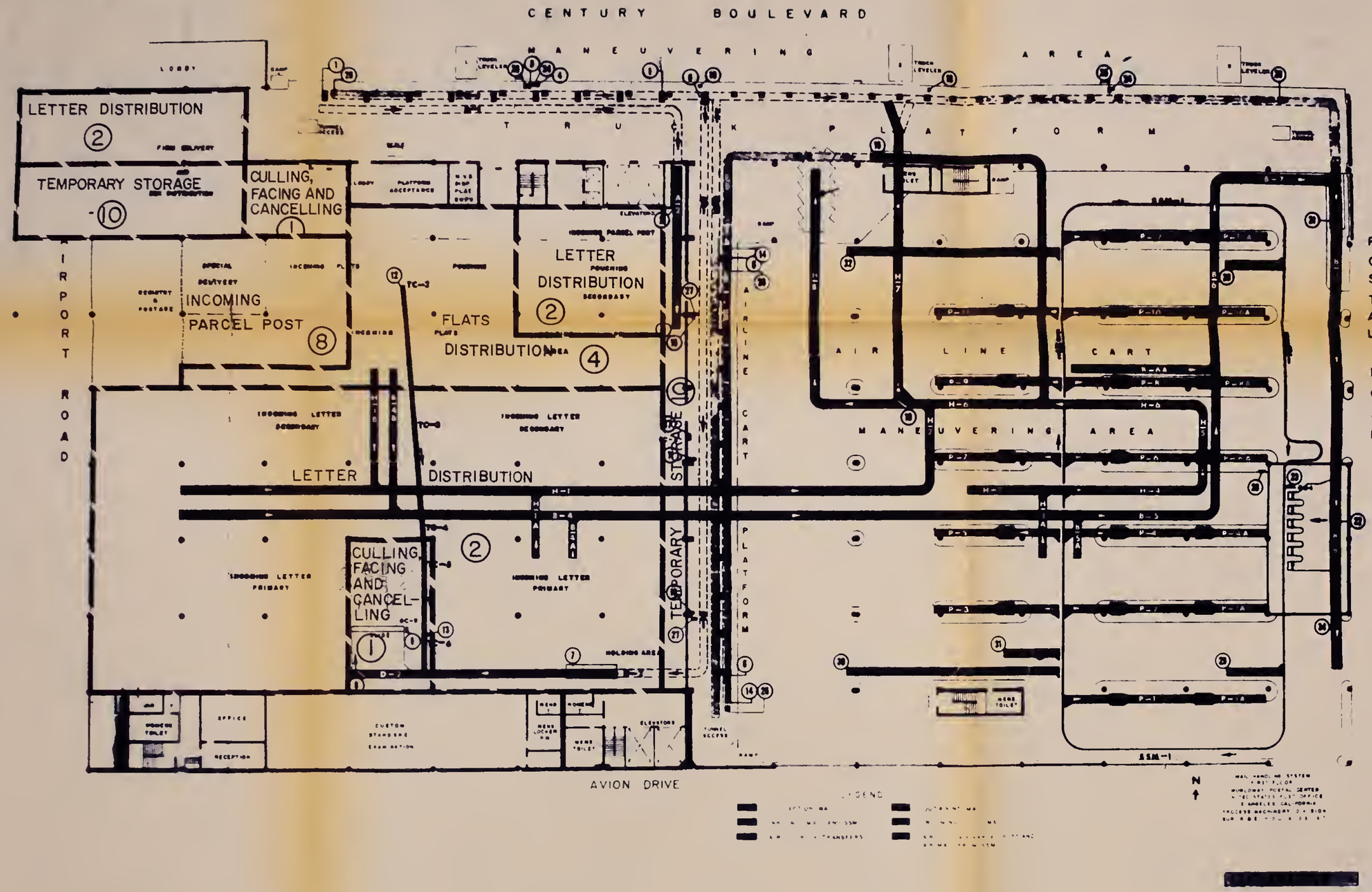


FIG. 5 - LOS ANGELES POST OFFICE FIRST-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

FIG. 6 - LOS ANGELES POST OFFICE SECOND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

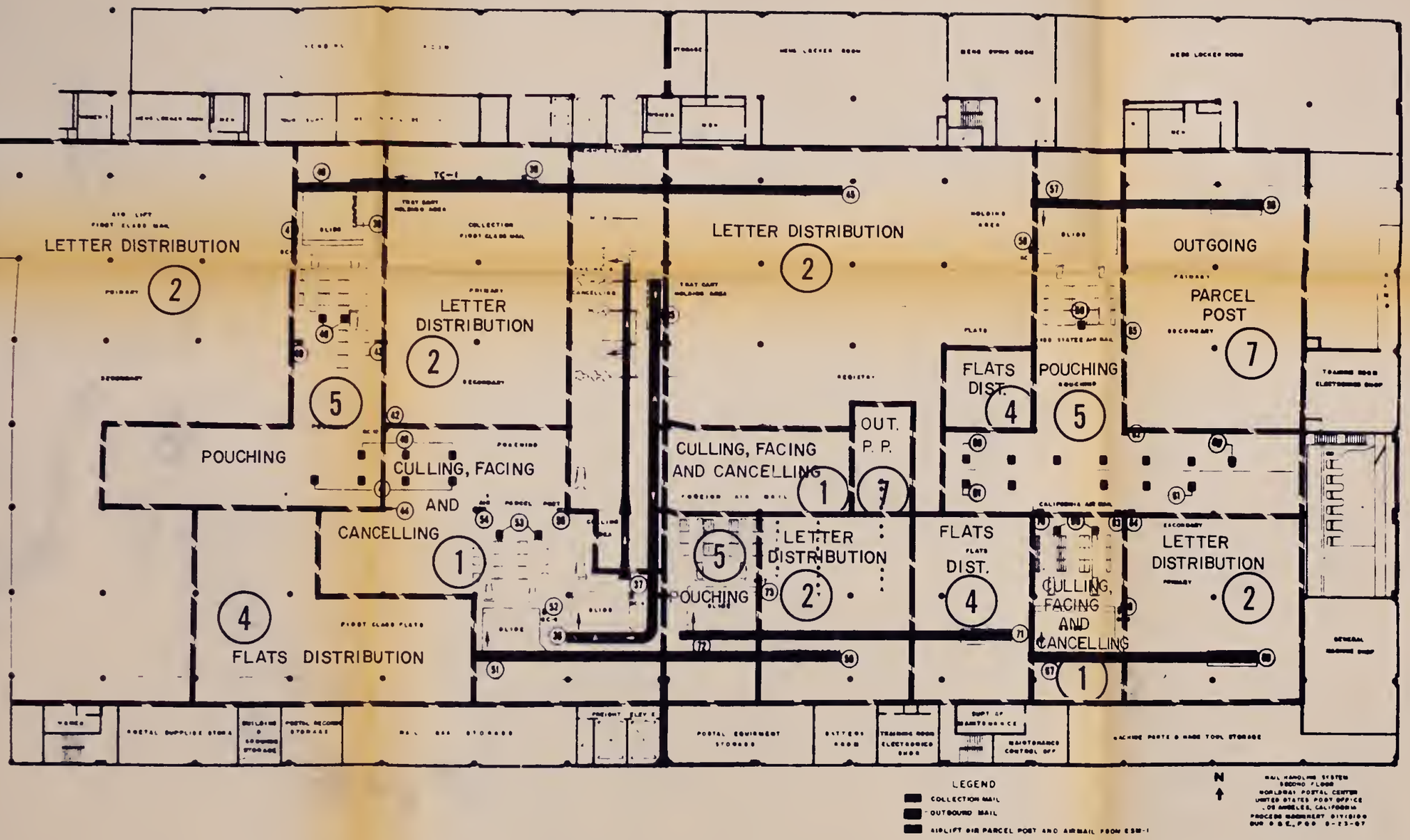
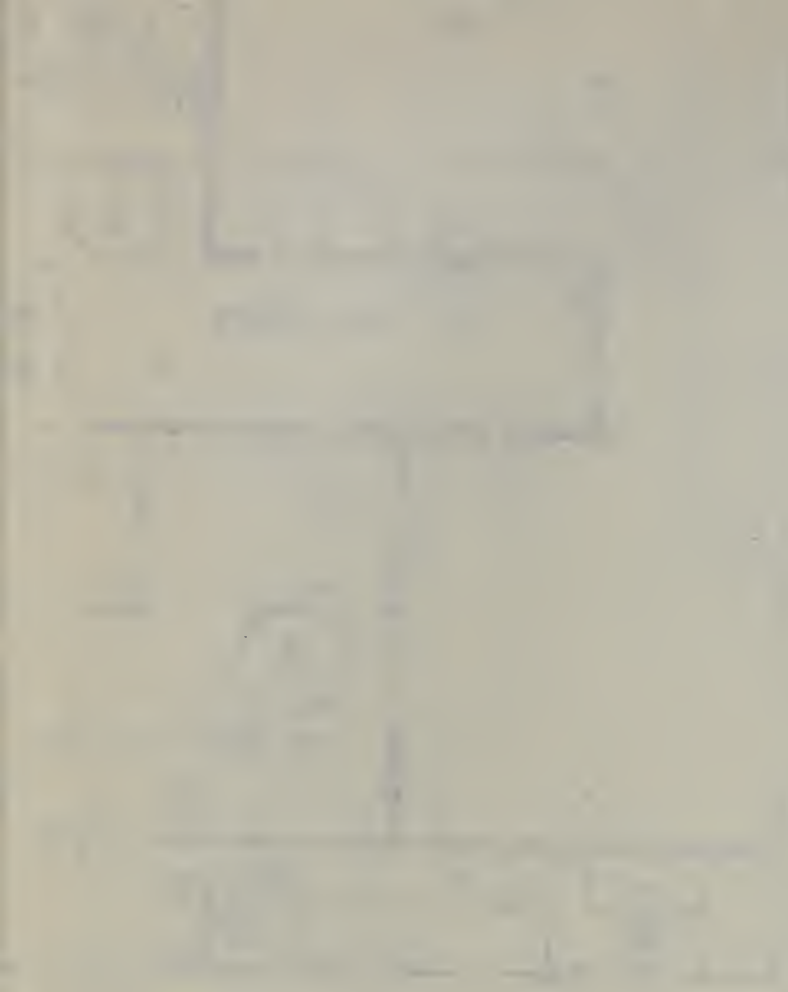


FIG. 6 - LOS ANGELES POST OFFICE SECOND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

FIG 7 - MECHANIZATION SECTIONS AT HOUSTON, FIRST FLOOR, SELECTED FOR DEAD WEIGHT DETERMINATION



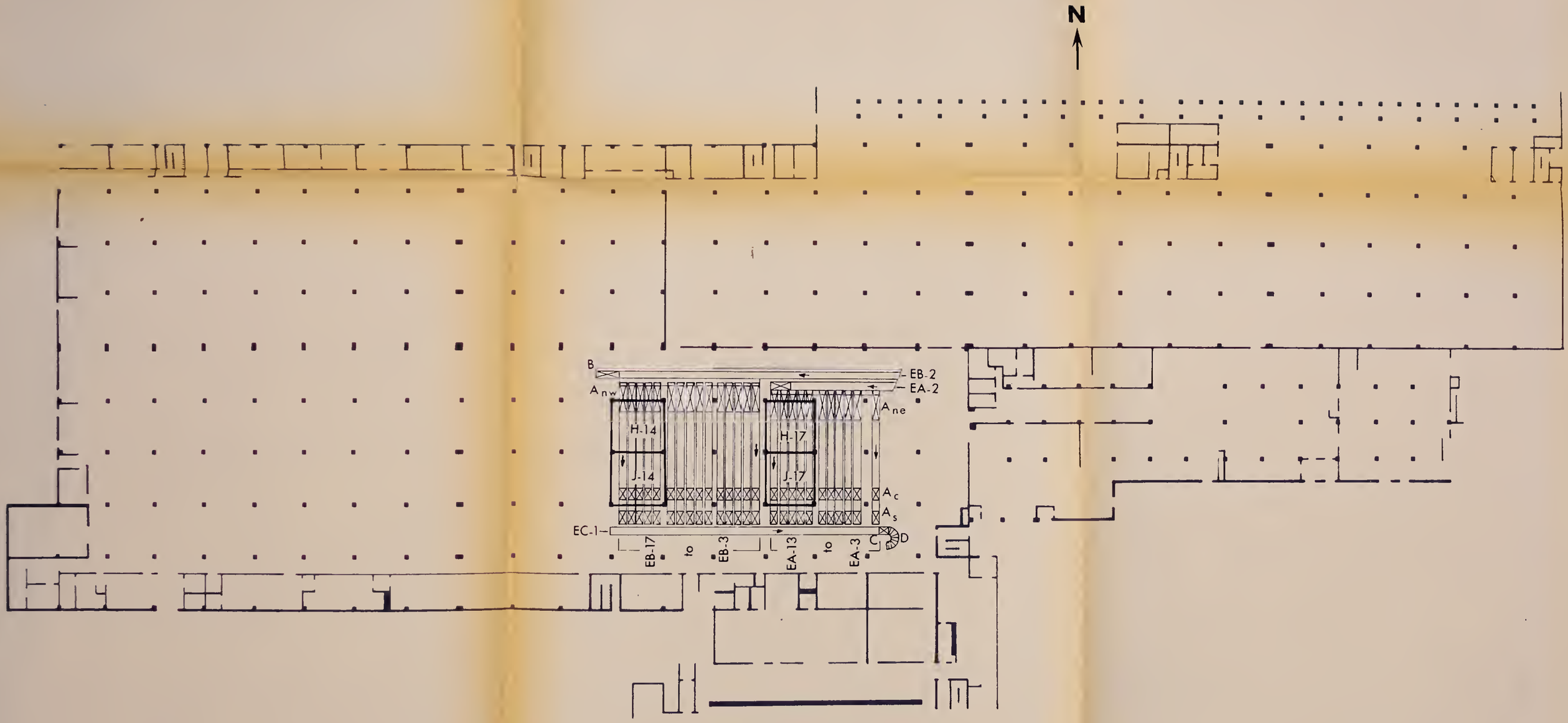
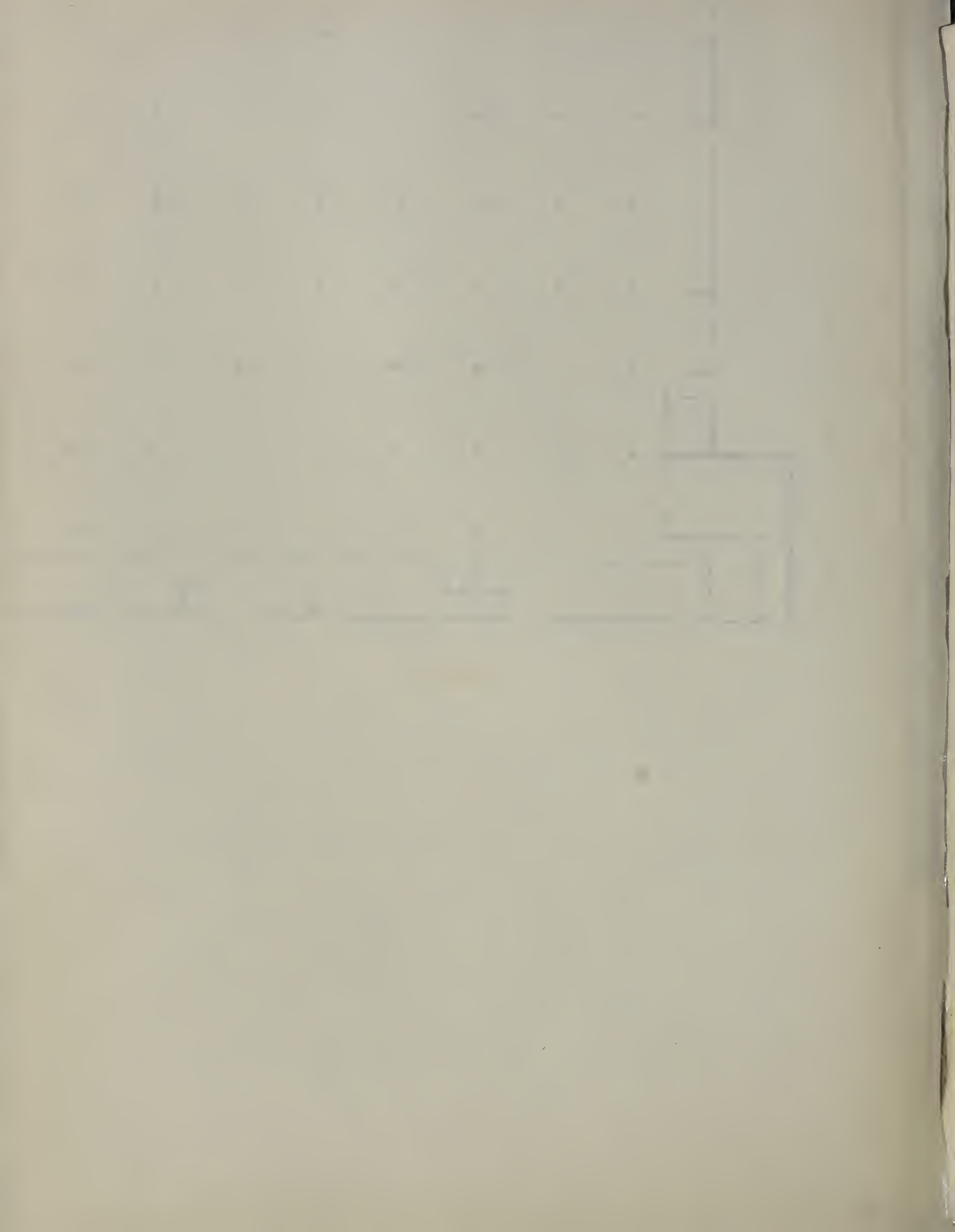
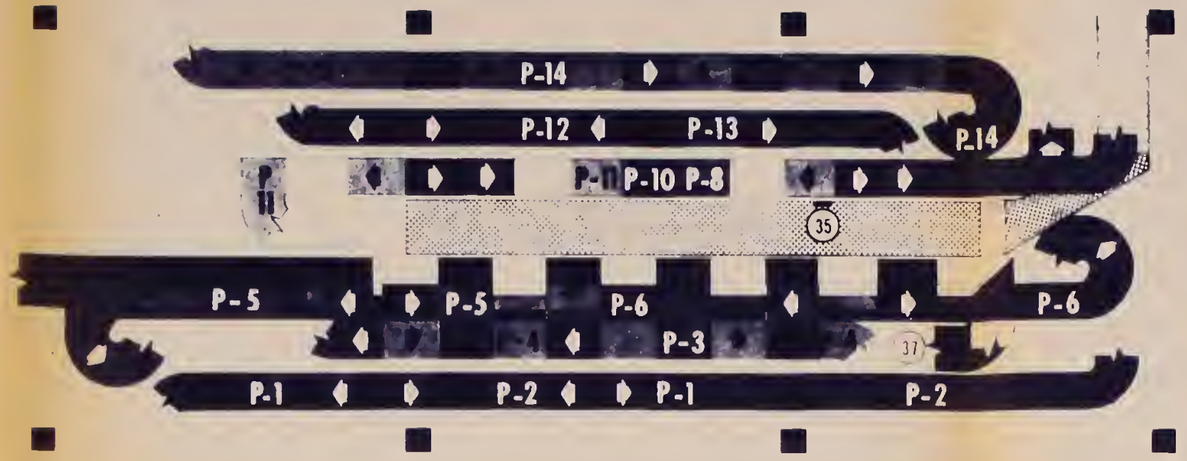


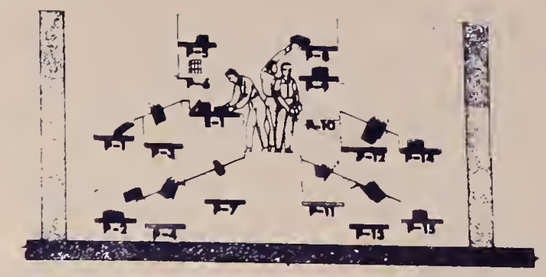
FIG 7 · MECHANIZATION SECTIONS AT HOUSTON, FIRST FLOOR, SELECTED FOR DEAD WEIGHT DETERMINATION

FIG 8 - MECHANIZATION SECTION AT NEW ORLEANS. SECOND FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION





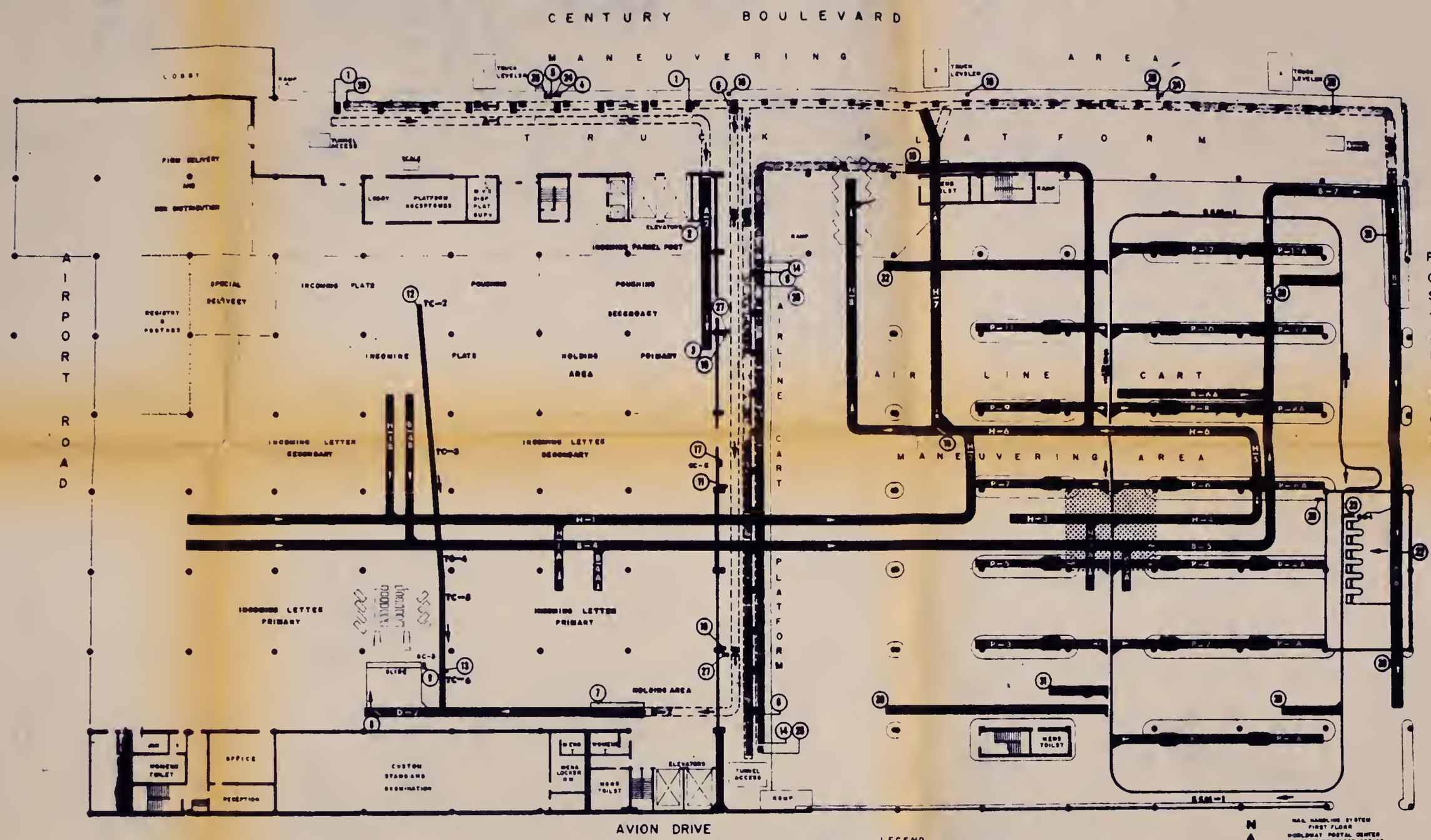
OUTGOING PARCEL POST
PRIMARY SEPARATION UNIT



CROSS SECTIONAL VIEW THROUGH
OUTGOING PARCEL POST
PRIMARY SEPARATION UNIT
FIGURE 8

FIG 8 · MECHANIZATION SECTION AT NEW ORLEANS. SECOND FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

FIG. 9 - MECHANIZATION SECTIONS AT LOS ANGELES. FIRST FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION



LEGEND

- COLLECTION MAIL
- INBOUND MAIL AND SSM-1
- AIR-TO-TRUCK TRANSFERS
- OUTBOUND MAIL
- INCOMING (CITY) MAIL
- AIR LIFT, AIR PARCEL POST AND AIR MAIL FROM SSM-1

MAIL HANDLING SYSTEM
FIRST FLOOR
HEADQUARTERS POSTAL CENTER
UNITED STATES POST OFFICE
LOS ANGELES, CALIFORNIA
PROCESS MACHINERY DIVISION
DWG. NO. PRS 8-26-67

[redacted]

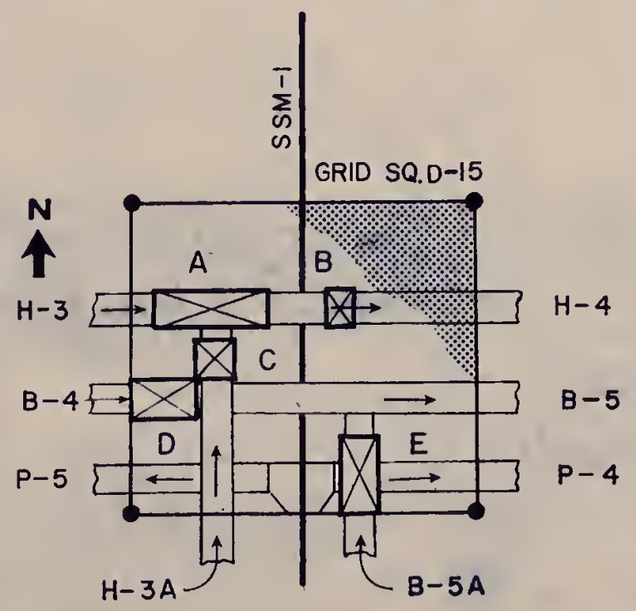


FIG. 9 - MECHANIZATION SECTIONS AT LOS ANGELES. FIRST FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

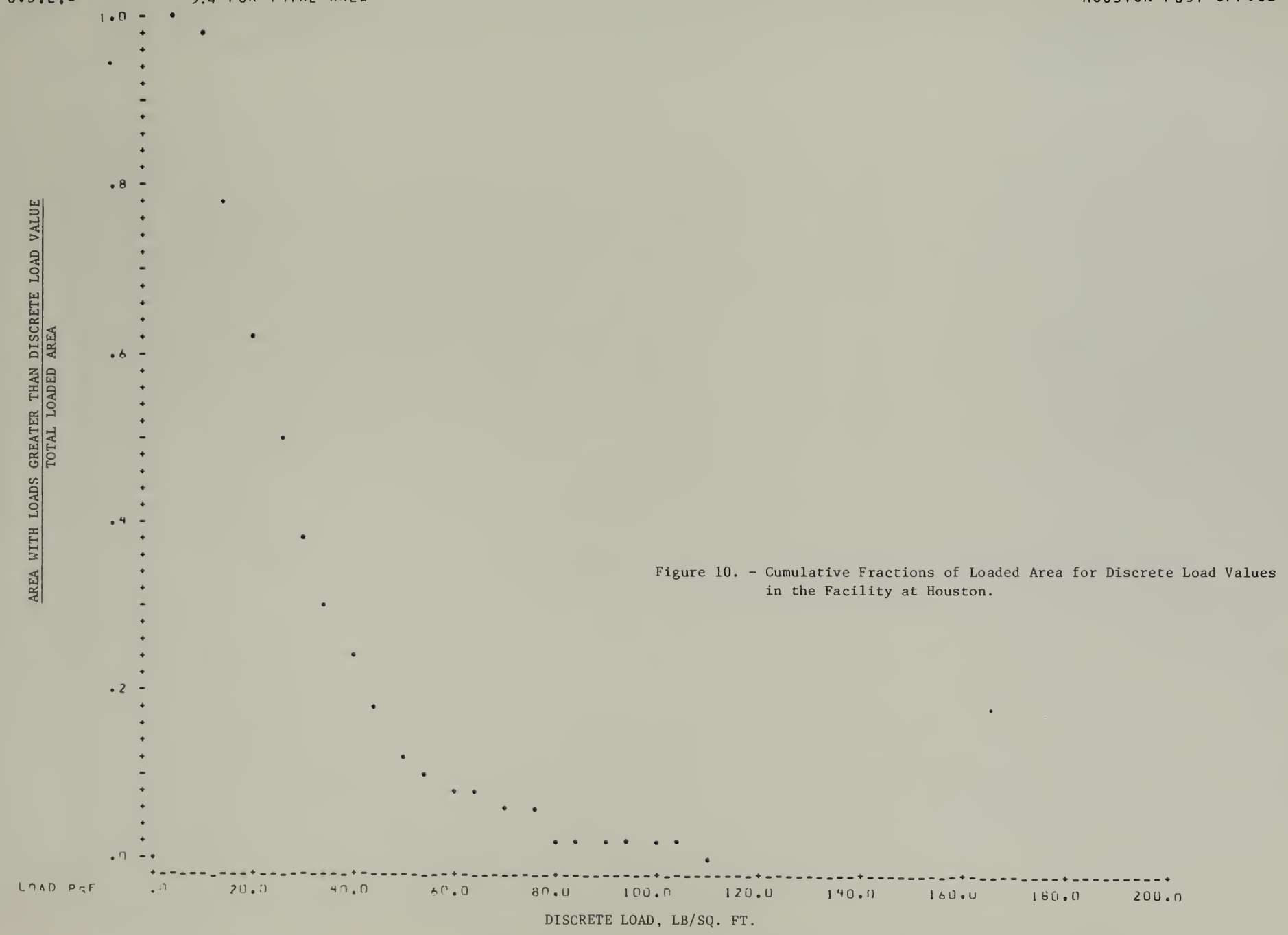


Figure 10. - Cumulative Fractions of Loaded Area for Discrete Load Values in the Facility at Houston.

CUMULATIVE FRACTIONS OF LOADED AREA CARRYING LOADS GREATER THAN A DISCRETE VALUE, WORK AREA, BDG.T.

TOTAL AREA= 221981.0 SQ.FT.
LOADED AREA= 71664.5 SQ.FT. = 32.3 % OF TOTAL AREA
ZERO LOAD= 150316.5 SQ.FT. = 67.7 % OF TOTAL AREA
U.D.L.= 10.5 FOR TOTAL AREA

NEW ORLEANS

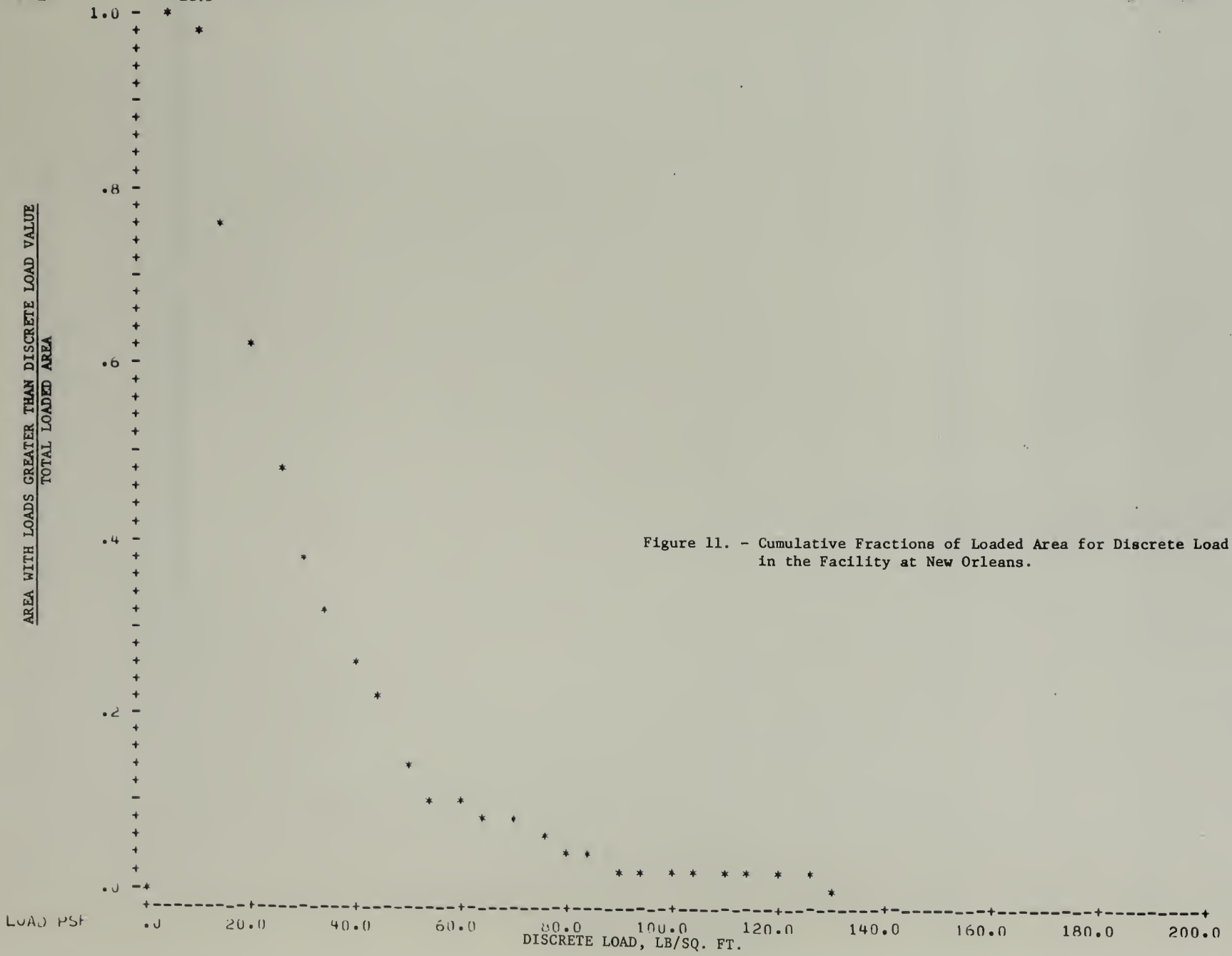


Figure 11. - Cumulative Fractions of Loaded Area for Discrete Load Values in the Facility at New Orleans.

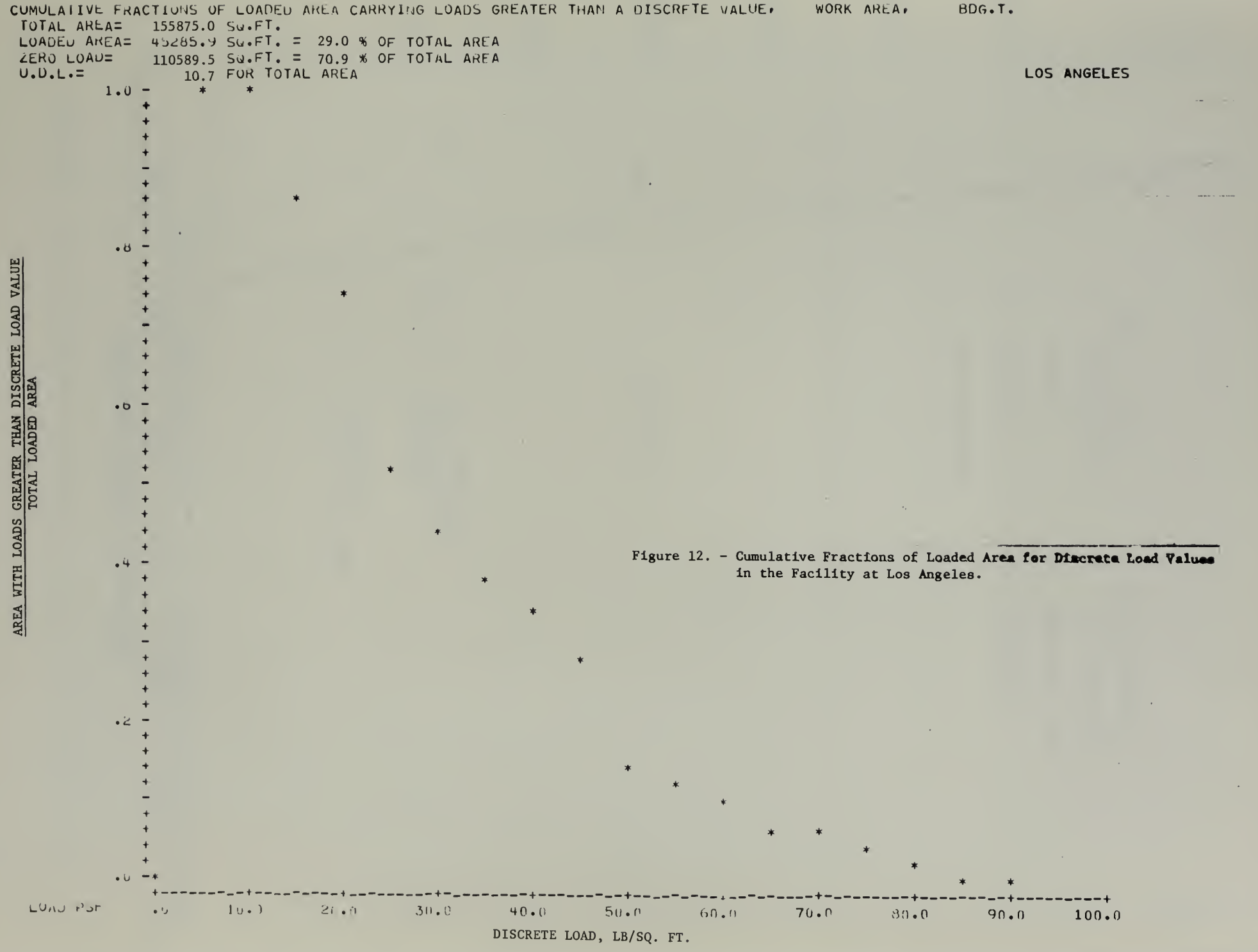


Figure 12. - Cumulative Fractions of Loaded Area for Discrete Load Values in the Facility at Los Angeles.

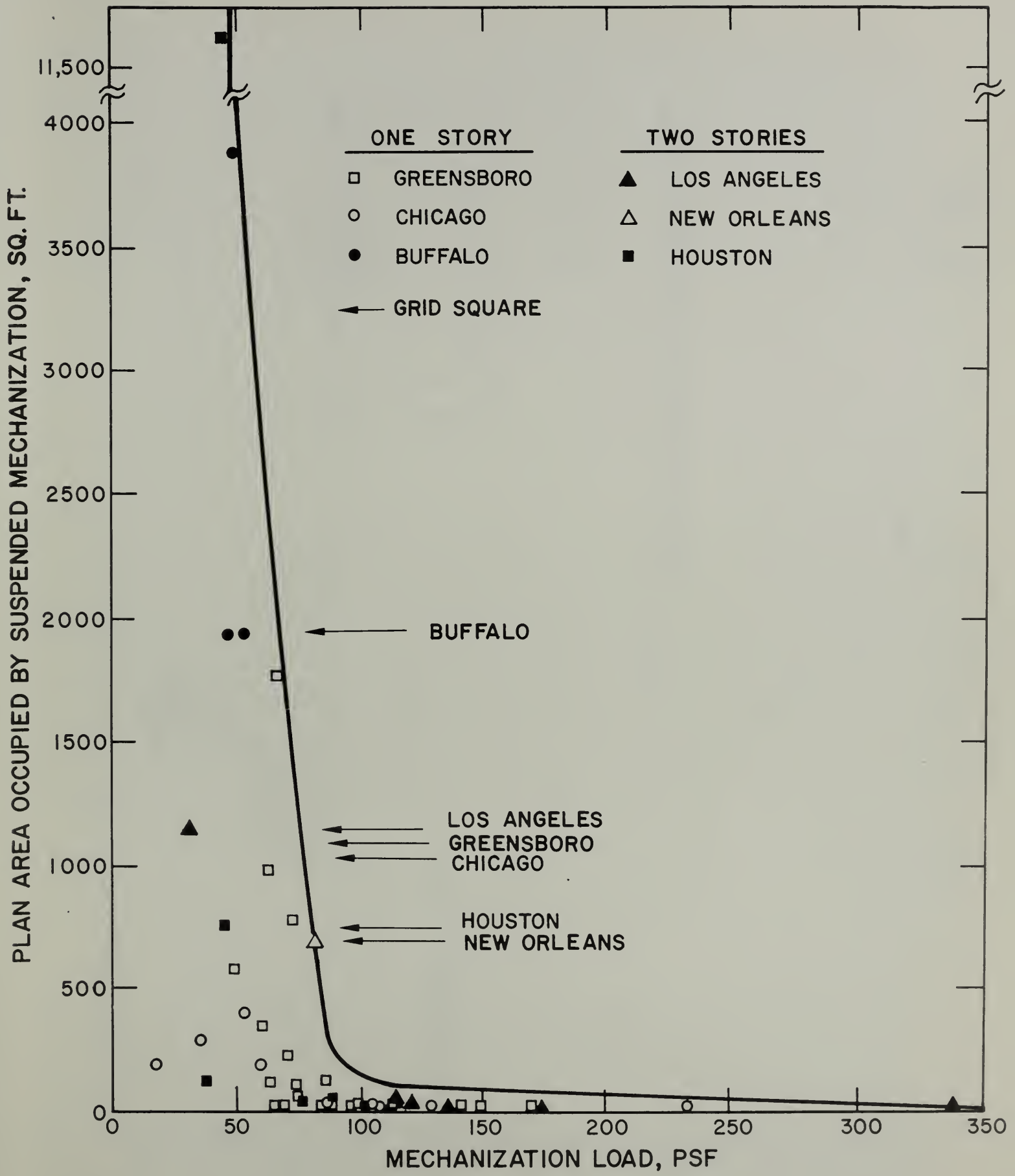


Figure 13. - Plot of Suspended Mechanization Loads vs. Plan Area of Sections.

CUMULATIVE FRACTIONS OF LOADED AREA CARRYING LOADS GREATER THAN A DISCRETE VALUE, WORK AREA, 1

TOTAL AREA= 8512.0 SQ.FT.
LOADED AREA= 1740.9 SQ.FT. = 20.5 % OF TOTAL AREA
ZERO LOAD= 6771.1 SQ.FT. = 79.5 % OF TOTAL AREA
U.D.L.= 6.5 FOR TOTAL AREA

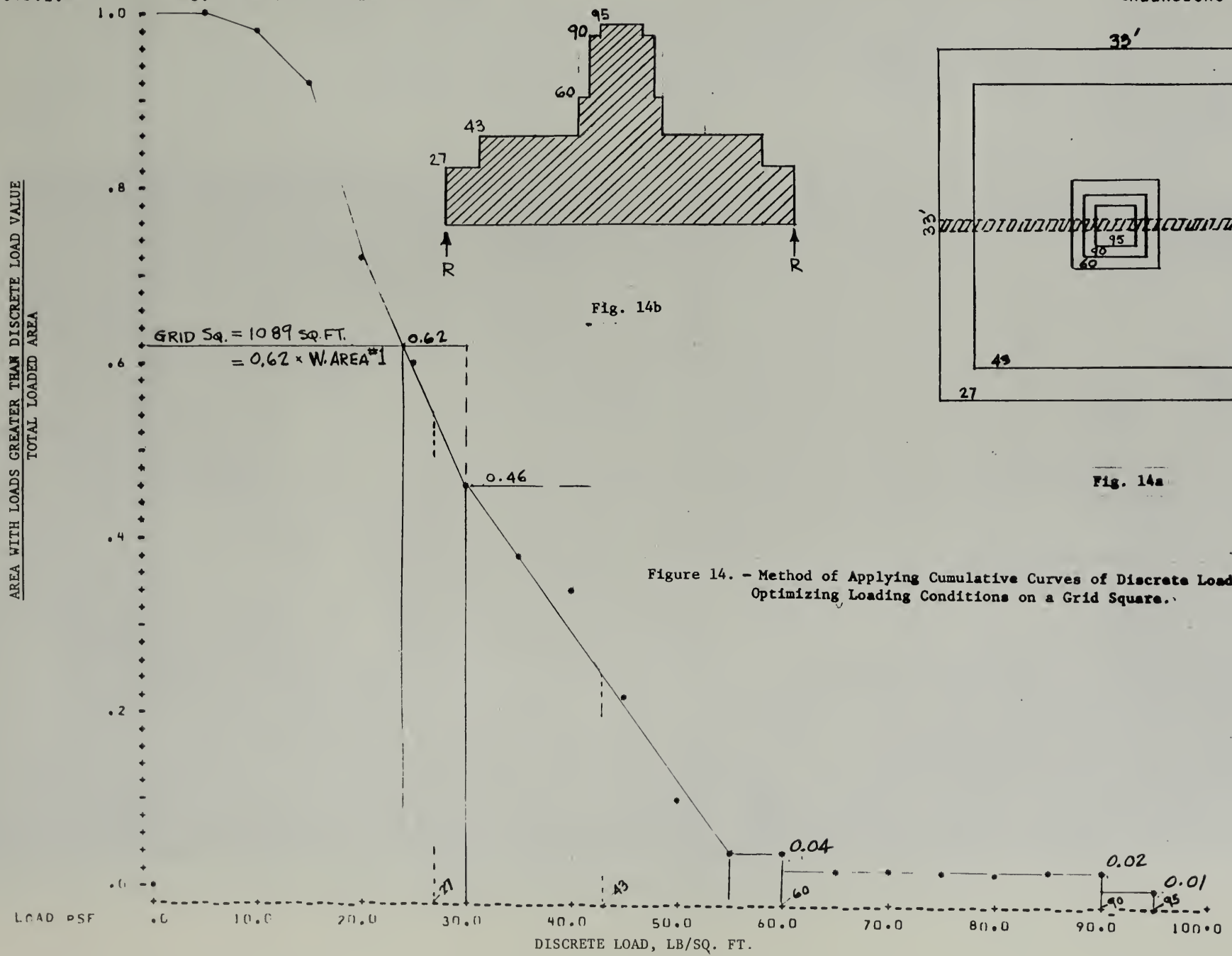


Fig. 14b

Fig. 14a

Figure 14. - Method of Applying Cumulative Curves of Discrete Loads for Optimizing Loading Conditions on a Grid Square.

FIG. 15 - LOADED NUTTING TRUCKS CLOSELY SPACED ON WORKROOM FLOOR.

FIG. 16 - FILLED MAIL SACKS PILED DIRECTLY ON WORKROOM FLOOR.


DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS